ASSOCIATIONS AMONG KNEE OSTEOARTHRITIS FEATURES ON MRI INFORM ABOUT POTENTIAL PATHOGENIC MECHANISMS, DATA FROM THE OAI/FNIH BIOMARKERS CONSORTIUM

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Purpose

To investigate **associations among osteoarthritis (OA) features on MRI of the patellofemoral (PF) and tibiofemoral (TF) knee compartments in knee OA**.

Methods

Data were derived from the **FNIH Biomarkers Consortium**, a nested case-control study within the Osteoarthritis Initiative, in which 600 people with knee OA were retrospectively selected for one index knee showing progression of either pain (N=103), medial TF joint space width loss (JSL, N=103), or both pain and JSL (N=194), and no progression (N=200) between 2 and 4-year follow-up.

MRIs of the index knee were obtained at 0, 1 and 2-year follow-up and scored for OA features in the PF, medial TF and lateral TF compartments, according to MOAKS. Features that were included in the current analysis are: cartilage (CART) morphology (size of any cartilage loss and proportion of full-thickness cartilage loss, respectively), bone marrow lesion (BML) size, osteophyte (OP) size, effusion-synovitis and Hoffa synovitis (SYN), medial and lateral meniscal (MEN) morphology and extrusion, and anterior cruciate ligament tear (ACLT).

For each feature, the maximum score per compartment was selected. **Associations among these features were studied by categorical principal component analysis** (CATPCA), investigating potential common underlying domains represented by these OA features by grouping them into components (factors). Components can be visualized as lines within a multidimensional dot plot of all variables in the model (i.e. OA features), every component catching the variability of each variable to a different degree.

Results

Table 1 shows the component matrix as obtained from CATPCA of baseline data. Numbers represent component loadings (i.e. correlation coefficients of variables with each particular component). Variables with more positive or more negative loadings are best represented by that particular component and, as such, can be grouped. Through comparison of models with different numbers of components, a model with three components was judged the most optimal (taking into account additive value of new components and internal consistency).

- **Component 1** loaded CART and BML features in all compartments except for the lateral TF compartment, OP features in all compartments, and medial MEN features.
- **Component 2** loaded CART and BML features in the PF compartment, but not OP features.
- **Component 3** loaded CART and BML features in the lateral TF compartment and lateral MEN tear, but not OP features.

	Component		
	1	2	3
CART defect size medial patellofemoral	**,401**	,297	**-,404**
CART defect size medial tibia and central femur	**,434**	**-,529**	-,233
CARTdefect size medioposterior femur	**,445**	**-,495**	-,088
CARTdefect size lateral patellofemoral	**,533**	**,589**	-,100
CART defect size lateral tibia and central femur	,352	,164	,391
CART defect size lateroposterior femur	,180	,064	**,623**
CART defect severity medial patellofemoral	,280	,372	-,355
CART defect severity medial tibia and central femur	**,422**	**-,470**	-,143
CART defect severity medioposterior femur	,277	**-,401**	-,023
CART defect severity lateral patellofemoral	**,491**	**,618**	-,081
CART defect severity lateral tibia and central femur	,219	,053	,358
CART defect severity lateroposterior femur	,067	,052	**,558**
BML size medial patellofemoral	,131	,340	-,256
BML size medial tibia and central femur	**,422**	**-,511**	-,158
BML size medioposterior femur	,154	**-,429**	,007
BML size lateral patellofemoral	,397	**,605**	-,062
BML size lateral tibia and central femur	,230	-,040	,342
BML size lateroposterior femur	,103	,003	,375
OP size medial patellofemoral	**,726**	,132	-,122
OP size medial tibia and central femur	**,738**	-,228	-,007
OP size medioposterior femur	**,740**	-,010	,085
OP size lateral patellofemoral	**,728**	,299	,033
OP size lateral tibia and central femur	**,785**	,152	,142
OP size lateroposterior femur	**,698**	,088	,078
Medial MEN tear	,326	**-,633**	,033
Medial MEN extrusion	**,469**	**-,454**	-,111
Lateral MEN tear	,107	,033	**,440**
ACLT	,236	-,267	,157
Explained variance (%)	5,7	3,7	2,0
Crohnbach's alpa	,855	,756	,519

Table 1. Component matrix as obtained from CATPCA at baseline. Component loadings lower than -.400 and higher than .400 are in bold. Negative loadings are in blue, positive ones in red. CART=cartilage, BML=bone marrow lesion, OP=osteophyte, MEN=meniscus, ACLT=anterior cruciate ligament tear.

SYN features and lateral MEN extrusion showed insufficient associations with the dataset as a whole to be retained in the model, but loaded maximally on component 1 if they were. The total explained variance of the model was only 11.4% and this hardly improved when the number of components was increased (data not shown). Results were almost identical at 1 and 2-year follow-up (data not shown).

Conclusions

- Cross-sectional associations among the current spectrum of OA features in the PF and TF compartments of knees with OA were limited (i.e. low total explained variance of models), but consistent between time points.
- CATPCA created components that differed with respect to the most affected compartment (i.e. medial TF vs. lateral TF vs. PF compartment) rather than predominating OA features (e.g. CART vs. OP features).
- CART and BML features clustered together per knee compartment more than OP size did.
- SYN features showed only very weak associations with other OA features.

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